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STUDY EXAMINES RELATIONSHIP BETWEEN LONG-TERM EXPOSURE TO FINE PARTICLES IN AIR POLLUTION AND CARDIOVASCULAR DISEASE

Issue:

While it is widely known that factors such as cigarette smoking and high blood pressure are linked to atherosclerosis (hardening of the arteries) and other forms of cardiovascular disease, studies indicate that long-term exposure to air pollution can also be associated with premature death from this disease.

Although scientific evidence is accumulating that supports the link between particulate matter (PM) in air and premature mortality and poor health, many questions about the health effects of PM remain unanswered. In 2001, the National Research Council highlighted a critical need for further research on the long-term health effects of PM exposure.

Scientific Objective:
In 2004, the U.S. Environmental Protection Agency's Clean Air

Research Program awarded a STAR research grant to the University of Washington to conduct the Multi-Ethnic Study of Atherosclerosis (MESA) Air Pollution Study—an unprecedented investigation of the impact of fine particles in air pollution on atherosclerosis and development of heart disease.

The MESA Air Study investigates these impacts among more than 6,000 participants over a 10-year period. Study participants have diverse backgrounds, and reside in nine locations across six states. The study is anchored on the Multi-Ethnic Study of Atherosclerosis (MESA), initiated in 1999 by the National Heart, Lung, and Blood Institute of the National Institutes of Health.

The MESA Air Study's main theory is that increased long-term exposure to $PM_{2.5}$ (fine particles less than 2.5 micrometers in

diameter) is associated with a more rapid progression of coronary atherosclerosis and an increased risk of coronary events, such as heart attacks.

To test this hypothesis, a host of air pollution and participant health measures are being collected and analyzed. Along with measuring PM concentrations and variability at the neighborhood, home and individual levels, the study is using data obtained from the national $PM_{2.5}$ monitoring networks to estimate long-term PM exposure levels for all of the study's participants.

Current Study Status:
Study participants have been enrolled at field sites in Chicago, Los Angeles County and surrounding area, Baltimore, St. Paul, New York City and nearby Rockland County, and Winston-Salem. The first of two clinical

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assessments has been completed. Participants are contacted annually to find out if they have had a heart attack or stroke, or been diagnosed with other cardiovascular disease. Deaths also are monitored in the study group.

A group of 3,600 participants are being assessed on two occasions for the presence of underlying, symptom-free atherosclerosis using two advanced, noninvasive medical techniques. Blood samples from a smaller group are being analyzed for markers which have been linked to a higher disease risk.

The second clinical assessment will occur during 2010 – 2011. The study is conducting a detailed assessment of exposure to fine PM, especially related to traffic emissions. Air sampling measurements at regional, residential, and roadside sites, questionnaire information, geographic, and other data are being used to develop individual estimates of long-term exposure. Progress has been made to integrate these and other data in a statistical method that accounts

for complex space (spatial) and time (temporal) relationships.

Interim estimates of long-term ambient PM concentrations have been developed for preliminary health effects analyses. These have shown that the nine study sites represent a broad range of long-term average fine PM levels.

The MESA Air study has become an attractive platform for additional studies that have expanded its research scope. Notably, the rich data set for cardiovascular endpoints are being investigated in relation to long-term exposure estimates for PM.

Application and Impact:

The MESA Air Pollution Study and additional studies involving the study group will add to scientific knowledge about the role of PM mass, composition, and sources in the progression of atherosclerosis and development of heart disease. Specifically, the study will provide:

- More precise estimates of cardiovascular disease risk associated with long-term exposure to ambient $PM_{2.5}$

- Improved methods and models to estimate long-term exposure that incorporate PM variability between and within locations
- Identification of groups especially susceptible to the effects of PM2.5 exposure due to racial/ethnic background, poor health status, older age, and other characteristics

The science will assist air quality managers with developing air pollution standards that protect the long-term health of the U.S. population, including susceptible individuals, and design effective management strategies that minimize exposure to unhealthy air.